Attachment A

American Geological Institute Government Affairs Program

Review of NASA's International Space Station

Prepared by Jenna Minicucci, Government Affairs Intern

Last Revised: August 13, 1997

Note: At the request of the Geological Society of America's Geology and Public Policy Committee, AGI is undertaking a series of federal agency and program reviews to assess their impact on the geosciences.

Introduction

In 1984, President Reagan launched the United States on a program to construct a permanently occupied space station in Earth orbit. After numerous revisions and designs, the program has evolved into today's International Space Station (ISS). The National Aeronautics and Space Administration (NASA) defines the purpose of the space station as providing "a long-duration laboratory to allow investigation of the limits of human performance, vastly expand human experience in living and working in space, and provide the capability to understand whether there are additional opportunities for the large-scale commercial development of space." Upon the completion of assembly, the station is expected to be the world's premier facility for studying the role of gravity in biological, physical, and chemical systems. But it is not without its critics, and its utility to the geoscience community is at best limited.

NASA expects that a continuous human presence in space will add to our knowledge of the effects of a microgravity environment on human health and development. Research scheduled to take place is expected to improve techniques used in drug development, helping to more effectively target specific diseases. Materials science research is also scheduled. NASA scientists expect that further investigation into the formative processes of materials in the space environment will enhance our understanding of formative processes on Earth, thereby making the creation of stronger, better materials possible.

NASA hopes that the space station will accelerate breakthroughs in technology and engineering and maintain U.S. leadership in space and global competitiveness. According to NASA officials, "the space station is a catalyst for international cooperation and a powerful symbol of U.S. leadership in a changing world." In testimony submitted to the House Science Committee on February 12, 1997, Dr. John Gibbons, Assistant to the President and Director of the White House Office of Science and Technology Policy, claimed that the space station program is "arguably the most significant and complex technological activity ever undertaken in peacetime by an international partnership. When completed, the space station will offer unprecedented opportunities for innovative scientific research and technology development." In addition to the science and technology purposes of the space station, NASA has also made several other claims about the station's benefits, including the following: the space station "will help focus the

aerospace industry of Russia and other countries on nonmilitary pursuits to reduce the risk of nuclear proliferation and slow the traffic in high-technology weaponry to developing nations." Statements made by Thomas F. Rogers, Advisor to the Space Frontier Foundation and Chairman of the Sophron Foundation, emphasize the program's potential to "facilitate the 'commercialization' of space."

Although we may be able to expect advances in some areas of science, most prominently in life science and biomedical research, as a result of the research efforts scheduled to take place aboard the Space Station, the earth sciences are not a primary benefactor. Geoscientists may benefit from fluid physics studies and materials science study of molten metal behavior, but research specifically directed towards geoscience questions is conspicuously absent from the plan.

Dissension in the Ranks

Reaction to the space station has not been uniformly positive. The scientific community is split on the program's overall value, as well as on whether or not such a significant initiative is necessary to accomplish the scientific goals that have been put forward. Dr. Robert Park, a physics professor at the University of Maryland and the Director of Public Information for the American Physical Society (APS), has taken a strong stand against the space station, arguing that its few scientific objectives have, for the most part, already been attained, and that the research planned for the station could be conducted aboard unmanned platforms and the Shuttle for far less money. Park issued the following statement at a NASA Authorization hearing in April: "It is the official view of the APS that scientific justification is lacking for a permanently manned space station in Earth orbit." Indeed, he went on to state that there is "almost universal concern among physicists that the priorities of the space program are seriously misplaced." Park's testimony was prepared in conjunction with biologists from Washington University in St. Louis, Berkeley, and Harvard. Park went on to state that he "h[as] yet to hear a single positive statement about the space station from an uninvolved scientist." Dr. Park emphasized that "the International Space Station is yesterday's technology and its stated scientific objectives are yesterday's science." He concluded by labeling the space station as an exercise in international cooperation, challenging that we should call it for what it is and "drop the pretense of scientific research."

The American Geophysical Union (AGU) also took an initial stand against the space station, though they later softened their position. The Union's position statement issued in May of 1994 confirmed concerns that the high cost of implementing the space station program will "detrimentally affect NASA's science programs." The AGU stated their agreement with a 1990 report issued by The Advisory Committee for the Future of the U.S. Space Program which argued for a balanced space program with science as the "fulcrum." According to the AGU, "implementation of the space station must not be allowed to cause the decline or demise of the exciting and important science elements of the national space program."

Criticisms of the space station are also heard in Congress. Rep. Tim Roemer (D-IN) has been a strong adversary of the space station from the beginning. Roemer claims that the program is lacking in scientific objectives, with the original eight objectives having been reduced to two. He also agrees with Dr. Park's assessment that the program will drain more resources than it will provide. Overall, criticisms of the space station center around

its actual scientific content and purpose and questions of its ability to perform research functions that simpler, less expensive technology cannot.

During Senate floor debate addressing the VA/HUD appropriations bill on July 21-22, 1997, Senator Dale Bumpers (D-AR) introduced an amendment to terminate the space station, pointing to a lack of real scientific merit and what he perceives as a better use of taxpayer dollars. "Do you have any idea, when we sit in the Agriculture Committee talking about research, how we have to grovel and fight and scratch and claw for every dime we get for research?...Do you know the National Institutes of Health can only fund one out of every four good scientific projects that are brought to them?...Do you know what real medical research could be done if we simply gave them the cost of one space shuttle flight? They could fund one out of every three proposals." However, as one might expect, there is no Congressional consensus on the benefits and drawbacks of the space station. Former astronaut and Senator John Glenn (D-OH) responded in favor of the space station, noting that "the international space station will continue research into fundamental physics. Scientists use low gravity to test fundamental theories of physics with degrees of accuracy that far exceed the capacity of earthbound science. Physics and low gravity expand our understanding of changes in the state of matter, including those changes responsible for high-temperature superconductivity. The long-term benefits will challenge and expand our theories of how matter organizes as it changes state..."

While opinions fall on both sides of the fence, some clarity can be found. The International Space Station is an extremely costly initiative, swallowing a large portion of a declining NASA budget with its constant price tag. Recent delays are only adding to that cost. In addition, other NASA programs are suffering because funds meant for scientific use are being transferred to cover station construction costs. It appears to be an appropriate time for evaluation of our national space program goals, and just what the space station may have to contribute.

The Science

Research planned for the space station can be broken down into the following categories:

*Combustion science...*NASA claims that breakthroughs in combustion science will have far-reaching effects for both the economy and the environment. For example, a 2% increase in burner efficiency would save the U.S. $8 billion per year. Included in the experiments planned is research to examine the differences between fire behavior on Earth and in microgravity. With these efforts, we will be able to observe certain aspects of burning that are hidden by the effects of gravity on Earth. Research in combustion science aboard the space station could lead to enhanced energy efficiency, reduced pollution, and improved processes for producing high-technology materials such as carbon fibers. Critics of the space station have pointed out that a considerable amount of combustion research has already been conducted aboard the Russian space station, Mir, and the Shuttle.

*Biotechnology...*Research planned for the space station includes protein crystal growth and tissue culturing, the latter of which may have applications in the development of new drug therapies for cancer as well as for transplant research. In testimony offered to the House Science Committee during a NASA Authorization hearing in April, Dr. Lawrence T. DeLucas of the Center for Macromolecular Crystallography emphasized the benefits of protein crystal research conducted in space, claiming that higher quality protein crystals obtained from space have provided new information about proteins implicated in

important biological processes as well as diseases such as heart disease and stroke, diabetes, viral hepatitis, bacterial and parasitic infections, influenza, cancer, and emphysema. Dr. Park and his colleagues from the biological community who contributed to his testimony would tend to disagree. According to Park, "years of growing protein crystals on the Shuttle and on Mir have made no discernible contribution to the determination of any new [protein] structures."

Physiology...The physiological research involves a cooperative program between NASA and the National Institutes of Health (NIH) that includes a series of flight experiments. The virtual reality technology that has already come out of the arrangement has strengthened NASA's program of neuroscience research, leading to new discoveries of sensory pathways and the nervous system's capacity to adapt. Because of the research slated to continue aboard the space station, we can now create three-dimensional maps of neurons within gravity-sensing tissues. Critics of the program question the necessity of expanding the experiment base of physiology research to include a continuously manned station, when less expensive research methods have provided valuable information and can be relied upon to continue to do so.

Materials science...Space station study will allow materials scientists to study and control the processes by which materials are formed. With these insights, NASA expects that they can design new alloys, ceramics, glasses, and polymers to improve the performance of products "ranging from contact lenses to car engines." Also scheduled for study in the materials science discipline are mathematical techniques to model the behavior of molten metals, research that may have significant implications for geology and the study of the inner Earth. Critics in the scientific community maintain that materials science research is one on the long list of scientific objectives already attained. According to Dr. Park, "years of research on the Shuttle and on Mir have produced absolutely no evidence that a micro-gravity environment offers any advantage whatever for processing or manufacture." Park offers a basic scientific principle for this seeming failure, stating, "gravitational forces are simply too weak relative to the forces that bind atoms and molecules to significantly affect most processes."

Fluid physics...Research to improve both our understanding and our modeling capabilities for fluid behavior is also planned for the International Space Station. According to NASA, knowledge of fluid behavior is essential to industrial activities. For example, NASA scientists maintain that "oil recovery from partially-depleted reservoirs depends on how liquids flow through porous rock." Critics acknowledge that fluid physics research in a micro-gravity environment is lacking, yet maintain that simpler and less expensive research methods should be employed. Basic experiments in turbulence and fluid phase transitions could be conducted on unmanned platforms or on the Shuttle.

Microgravity physics...NASA expects research conducted aboard the space station in this discipline to advance our understanding of theories relevant to "everything from high-temperature superconductivity to weather prediction," an extraordinary claim. Whereas many members of the scientific community recognize the value of testing and examining the tenets upon which many of our current scientific beliefs rest, they question the need for a multi-billion dollar, manned space station to accomplish those objectives.

Gravitational biology...Scientists aboard the station also plan to study gravity's influence on the development, growth, and internal machinery of life, including individual cells as well as complete plants and animals. It is expected that research in this area will provide

long-term benefits in medicine, agriculture, and industry. But, as far as human health is concerned, the effects of micro-gravity have already been carefully documented. We have seen evidence from the Shuttle and from Mir of reduced bone density and diminished immune function, effects much more deleterious than anyone had suspected. In the words of Dr. Park, "another ten years of urine assays on a space station is not going to tell us much we don't already know." In addition, experiments conducted aboard the Shuttle and Mir have already established that such diverse organisms as flies, plants, and small mammals can go through their full life cycles in a micro-gravity environment. We already know that important processes in biology such as cell-cycle regulation and cell differentiation can occur in space.

Earth science research is decidedly absent from the scientific focal areas of the International Space Station. It was included in the fact book, however, as an area of research that will be involved, but has yet to be described in detail. Requests submitted to the overseeing NASA official for additional information regarding the program's Earth science elements have gone unanswered.

The Space Station

The space station program draws on the resources and scientific expertise of fifteen countries, including Canada, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, the U.K., Japan, Russia, and the U.S. One international crew, composed of two Russians and one American, is now training for a five-month tour of duty aboard the space station.

When assembled, the station's end-to-end wingspan will reach 356 feet. The station will be 290 feet long and weigh in at 470 tons. The maximum crew capacity will be seven. Once complete, the space station will be permanently occupied by a crew of six, and it is anticipated that it will remain fully operational for ten years following its planned completion in June 2002.

Space station construction has been divided into three phases:

Phase I (1994-1997)...During Phase I, scientists will utilize existing resources, namely the space shuttle and the Russian space station Mir, to build experience in the technical aspects of station construction and occupation.

Phase II (November 1997-February 1999)...Phase II begins the assembly process, during which the first "production" experiments will be conducted on board. In May of 1998, permanent occupation of the station is expected to commence with a crew of three. The end of Phase II will be marked by the delivery of the U.S. Laboratory Module on Shuttle Flight STS-94.

Phase III (February 1999-June 2002)...Phase III marks the permanent occupation of the Space Station by a crew of six. The U.S. Habitation Module, the Japanese Experiment Module (JEM), and the European Columbus Orbiting Facility (COF) will all be added at this time. Once assembly has been completed, the Space Station will commence full operational use.

It should be noted that these time estimates are ahead of the current schedule, as slippage of up to a year from this initial plan has occurred.

The Hardware

The Space Station will have multiple components and most have associated acronyms, so things can get somewhat confusing. The Canadian Mobile Servicing System (CMSS) includes a 55-foot robot arm with 125-ton payload capability, as well as a mobile

transporter, which can be positioned along the Integrated Truss Structure (ITS) for robotic assembly and maintenance operations. The Functional Cargo Block (FGB-Russian acronym) includes the energy block, contingency fuel storage, propulsion, and multiple docking points. The Russian Service Module provides life support and utilities, thrusters, and habitation functions. Power for the station's science and operations will be provided by the Science Power Platform (SPP). Crew Transfer Vehicles (CTV's) include a modified Russian Soyuz TM capsule and another vehicle yet to be determined. Supplies and reboost propellant will be carried to the station by unmanned Automated Transfer Vehicles (ATVs).

Upon full assembly, the Space Station will contain six laboratories. The two U.S. lab modules will include a laboratory and a Centrifuge Accommodation Module (CAM). Two Russian Research Modules will also be on board. The Japanese Experiment Module (JEM) and the European Space Agency (ESA) Columbus Orbital Facility (COF) will round out the laboratory provisions. The Japanese Experiment Module (JEM) has an attached exposed platform, with ten mounting spaces for experiments. This so-called "back porch" will provide direct contact with the space environment for experimentation. Four locations on the truss for mounting experiments intended for looking down at Earth and up into space will complement the direct exposure capability of the experimentation facilities. In addition to the six main laboratory spaces, the station will also include three Italian Mini Pressurized Laboratory Modules (MPLMs) which will carry all of the pressurized cargo and payloads launched on the Space Shuttle.

The U.S. Habitation Module will contain the galley, toilet, shower, sleep stations, and medical facilities. The structural building blocks that link the pressurized modules together are termed Nodes. Node 1 will be used for storage space only. Node 2 will contain racks of equipment used to convert electrical power for use. To maximize the power available to the Space Station, there will be four large U.S. photovoltaic arrays which rotate to face the Sun.

The Assembly Schedule

The assembly process will be accomplished by a somewhat complex mechanism whereby elements are launched from Russia and the U.S. and will be assembled on-orbit by cosmonauts and astronauts. There are a total of 28 U.S. Space Shuttle flights planned. Out of that total, 22 are assembly missions and six are utilization and outfitting missions. Out of a planned total of 41 Russian flights, ten are assembly missions, ten are crew transport missions, and 21 are logistics missions (propulsion and resupply). The complete schedule of assembly flights is included in Appendix A at the end of this report.

For additional information about the International Space Station, visit the Space Station website .

The Money

The FY 1998 NASA Authorization bill, H.R. 1275 , passed the House on April 24. As yet, no Senate companion measure has been introduced. As passed, the measure authorizes \$2.1 billion for the International Space Station, equaling NASA's request. Within that \$2.1 billion, the House measure "fences" Space Station research funding of \$400.5 million for administration only by the NASA Office of Life and Microgravity Sciences. This provision restores Station research funding to previously planned levels, and, if enacted, would result in a \$155 million cut in Space Station development. H.R.

1275 also contains a number of restrictions and reporting requirements regarding the Space Station program which are included below.

As part of the mark, the Subcommittee added $100 million to the Human Space Flight appropriation for continuation of "Russian Program Assurance" funding in FY 1998, consistent with the Administration's recommendation for a "placeholder" to address specific U.S. program requirements resulting from delays on the part of Russia in meeting its commitments to the space station program and uncertainties about future Russian performance (see following section). The Subcommittee mark also includes an augmentation of $48 million for the Science, Aeronautics, and Technology (SAT) appropriation, comprised of a series of earmarks. Finally, the Subcommittee has included transfer authority of up to $150 million for the International Space Station program, to be derived from the SAT and Mission Support appropriations.

A hearing held by the Senate Science, Technology, and Space Committee on June 18, 1997, addressed the space station program costs and reserves. Asked whether the Space Station funding was hurting other agency programs, such as space science, NASA Administrator Daniel Goldin declared that "NASA hasn't had a stronger space science program then today in a decade or two!" To Subcommittee comments about the split in the science community regarding the value of the Space Station, former station senior scientist Lawrence DeLucas stated that he believed "in a year on the Station, the science done will exceed that done on the Shuttle, Skylab, and in the whole history of NASA." At the hearing, Goldin also confirmed that costs have been running 20% higher than expected in recent months and program reserves are "very tight;" of $3 billion in reserves, the space agency has $2.1 billion left. Thomas Schultz of the General Accounting Office (GAO) suggested that if costs continue to grow, Congress should review the program. Schultz also reported that NASA has shifted hundreds of millions of dollars to Space Station construction from an account intended for science experiments on the Station, with the intent to repay some of that amount in future years. More recently, in Senate floor debate on the VA/HUD appropriations bill that occurred on July 21-22, 1997, Senator Dale Bumpers (D-AR) introduced an amendment to terminate the space station and expressed his concerns about budget priorities and funding transfers: "Why did NASA transfer $462 million from its science account to the manufacturing of the space station? To cover the cost overruns. And the $462 million comes out of the science budget. Either you are going to reduce the scientific experiments on this thing by $462 million, or NASA is going to come back to Congress and say we need $462 million more. Which do you think that is going to be? We all know what it is going to be, and this is just the beginning."

The International Space Station factbook contains the following cost estimates:

Component	**Cost**
Preliminary design (1985-1987)	$0.6 billion
Station-related design/development	$0.7 billion
Development	$8.9 billion
NASA estimate for Assembly Complete	**$17.4 billion**
FY 94-96 development, utilization, payloads, Mir support	$6.4 billion

Cost to go (1997-June 2002)	**$11.0 billion**
Development	$4.4 billion
Operations	$4.1 billion
Utilization support	$0.3 billion
Payloads and Mir support	$2.2 billion
Operations (2003-2012)	$13.0 billion

The Russia controversy

Earlier this year, NASA threatened to cut Russia out of the space station program because of missed deadlines and Russia's failure to pay its share of the costs. It has been a rocky road for ISS funding in general, and the difficulties with Russia sparked Congressional comment and involvement. House Science Committee Chairman F. James Sensenbrenner (R-WI) commented, "The Administration has ignored this problem in hope that it would resolve itself. It is not resolved, and Congress has been forced to impose a decision process and schedule on the Administration." What Congress had in mind was a bipartisan amendment offered by Sensenbrenner and Science Committee Ranking Member George Brown (D-CA). The amendment was included in H.R. 1275, the FY 1998 NASA Authorization Bill, and contains the following five provisions:

1) prohibits NASA from transferring any money to Russia or its contractors to perform work on Station elements pledged to be built by, and at the expense of, the Russians,
2) requires NASA to develop a contingency plan with decision points for removing each element of Russian hardware in the critical path,
3) directs the NASA Administrator to certify every month to Congress that the Russians are, or are not, meeting their monthly obligations and judgment on whether the First Element Launch will, or will not, launch by October 31, 1998,
4) requires the President to make a decision by August 1, 1997 on whether to proceed with permanent replacements for the Russian critical path items. The President must certify the reasons for, and the cost implications of, the decision. If the President decides to replace the Russian elements after August 1, 1997, he must certify the cost implications of making the decision later, and
5) directs the NASA Administrator to certify that Mir meets or exceeds U.S. safety standards before sending another astronaut for a long-term stay.

The Science Committee overwhelmingly rejected another amendment sponsored by Rep. Tim Roemer (D-IN) which would eliminate funding for the Space Station and an amendment, also sponsored by Roemer, which would have removed the Russian government as partners in the International Space Station. Afterwards, Sensenbrenner stated, "Our message to the White House is simple and clear. We support the International Space Station and international cooperation in space. However, Russia's inability to meet its commitments and the Administration's failure to develop and implement a timely contingency plan threaten the viability of the entire program. By holding the Administration to firm deadlines, we hope to force it to confront reality and solve the Station's problems. We have purposely given the Administration time and the

opportunity to fix the International Space Station before Congress is forced to remove Russia from the program."

In mid-May of this year, House and Senate appropriators gave NASA the green light to use $130 million in Space Shuttle funding to cover the costs resulting from the Russian-induced delays. NASA Station Chief Randy Brinkley remains optimistic, commenting that "this funding problem is behind us." On the flip side, Chairman Sensenbrenner remains skeptical that Russia will meet its obligations. As he told Science magazine in April, "I don't think we can trust the Russians for anything."

At the June 18 hearing of the Senate Science, Technology, and Space Subcommittee, testimony was given concerning Russia's ability to fulfill its commitments to the International Space Station. NASA Administrator Goldin said he expected the Russians to meet the most recent delivery date for their service module. However, he noted that NASA is also committing funds to a contingency plan, should the Russian module encounter further delays. During the question and answer period, Goldin reiterated his frequent claim that "inclusion of the Russians as partners provide[s] substantial gains to the program, both in hardware and in experience." He added that the U.S. would have to add back a significant amount of money were the Russians to withdraw. Goldin also defended, "we never said this complex, precedent-setting project would be easy."

The Congressional Tug-of-War

In addition to the criticisms of the scientific community, the road for space station development has also been rocky in Congress. Rep. Tim Roemer of Indiana stands out as the chief opponent of the program. Roemer has introduced numerous amendments (June 18, 1995; May 30, 1996; April 23, 1997) and bills (May 23, 1995; April 11, 1997; April 23, 1997) to bring about the station's demise. His criticism centers around the fact the station has increased in price since its conception and has simultaneously decreased in scientific value. Roemer is not alone in his opposition. In fact, his most recent bill introduction boasted of 32 cosponsors, and the support of several budget and taxpayer advocacy groups including the National Taxpayers' Union, the Concord Coalition, Taxpayers for Common Sense, Citizens Against Government Waste, and Citizens for a Sound Economy.

Once projected to cost $8 billion and span a ten year timeframe, recent projections by the Government Accounting Office estimate the lifetime cost of the space station at $94 billion, an increase of 1075%. According to Roemer, "the space station is a cannibal in the NASA budget." In addition, Roemer criticizes the fact that only two of the original eight scientific objectives remain. The station was once intended to be an orbiting medical lab, a staging area for crews and equipment to be assembled for manned trips to Mars, a factory for making drugs and other materials in micro-gravity conditions, and a platform for observing stars and planets. In Roemer's view, the original rationale for the space station, scientific merit, has "shrunk" considerably. In addition, the scientific objectives which remain could be investigated aboard unmanned platforms or aboard the Shuttle for a fraction of the cost.

Roemer has also predicted that problems with the Shuttle and Russian-induced delays reveal long-term problems for the space station. Already, the "U.S. taxpayer has been forced to pay $400 million in additional costs to Moscow." In addition, a recent report of the National Academy of Sciences conluded that parts of the space station as designed would be vulnerable to meteorites and orbital debris. "We must decide whether to put

taxpayer funds into one expensive project that may not work or whether we could better use those resources for less expensive, unmanned space flights that have solid scientific merit." According to Roemer, "every way you look at it, the space station does not deserve the support of hard-earned taxpayer dollars." Eliminating the space station program now would save taxpayers $78 billion, four times what has been spent so far. But, it is arguable that the program's elimination at this point, after significant pressure has been put on Russia, would do little for our international reputation.

Appendix A: Complete Assembly Schedule

Date	Flight	Launch Vehicle	Element(s)
June 1998	**1 A/R**	Russian	Functional Cargo Block (FGB)
July 1998	**2A**	U.S. Orbiter	Node 1 Pressurized mating adapters (PMAs)-1 & 2
Dec. 1998	**1R**	Russian	Service module
Dec. 1998	**2A.1**	U.S. Orbiter	TBD Logistics
Jan. 1999	**3A**	U.S. Orbiter	Integrated Truss Structure (ITS) Z1 PMA-3 Ku-band Control Moment Gyros (CMG's)
Jan. 1999	**2R**	Russian	Soyuz
Mar. 1999	**4A**	U.S. Orbiter	ITS P6
May 1999	**5A**	U.S. Orbiter	MPLM (Lab outfitting flight) Ultra High-Freq. (UHF) Antenna Space Station Remote Manipulating System
Aug. 1999	**7A**	U.S. Orbiter	Joint airlock High pressure gas assembly
Oct. 1999	**7A.1**	U.S. Orbiter	TBD U.S. outfitting
Dec. 1999	**4R**	Russian	Docking compartment 1
Jan. 2000	**UF-1**	U.S. Orbiter	MPLM (ISPRs) Photovoltaic (PV) module batteries
Feb. 2000	**8A**	U.S. Orbiter	ITS SO Mobile Transporter (MT)
Mar. 2000	**UF-2**	U.S. Orbiter	MPLM (ISPRs) Mobile Base System Lab system
June 2000	**9A**	U.S. Orbiter	ITS S1 Crew and Equip. Translation Assembly (CETA) cart A
July 2000	**9A.1**	U.S. Orbiter	Science Power Platform (SPP) with 4 solar arrays
Oct. 2000	**11A**	U.S, Orbiter	ITS P1 CETA cart B
Nov. 2000	**12A**	U.S. Orbiter	ITS P3/P4

Dec. 2000	**3R**	Russian	Universal docking module
Dec. 2000	**5R**	Russian	Docking compartment 2
Mar. 2001	**13A**	U.S. Orbiter	ITS S3/S4
Apr. 2001	**10A**	U.S. Orbiter	Node 2 Nitrogen tank assembly
May 2001	**1J/A**	U.S. Orbiter	JEM Experimental Logistics Module (ELM) PS ITS P5 High pressure oxygen tanks
Aug. 2001	**1J**	U.S. Orbiter	JEM PM
Sept. 2001	**UF-3**	U.S. Orbiter	MPLM International Standard Payload Racks (ISPRs)
Jan. 2002	**UF-4**	U.S. Orbiter	AMS Express pallet
Feb. 2002	**2J/A**	U.S. Orbiter	JEM EF ELM ES PV Module batteries
Feb. 2002	**9R.1**	Russian	Docking & stowage module-1
May 2002	**9R.2**	Russian	Docking & stowage module-2
May 2002	**14A**	U.S. Orbiter	Cupola & port rails 4 SPP Solar arrays
June 2002	**UF-5**	U.S. Orbiter	MPLM (ISPRs) Express pallet
TBD*	**2E**	U.S. Orbiter	MPLM (system stowage) JEM small fine arm ITS S5
TBD*	**8R**	Russian	Research module 1
TBD*	**16A**	U.S. Orbiter	Habitation module
TBD*	**10R**	Russian	Research module 2
TBD*	**17A**	U.S. Orbiter	MPLM (Habitation) PV module batteries High pressure oxygen tank
TBD*	**11R**	Russian	Life support module 1
TBD*	**12R**	Russian	Life support module 2
TBD*	**18A**	U.S. Orbiter	CRV 1
TBD*	**19A**	U.S. Orbiter	MPLM
TBD*	**15A**	U.S. Orbiter	PV Module S6
TBD*	**UF-6**	U.S. Orbiter	MPLM (ISPRs) Attached payloads
TBD*	**UF-7**	U.S. Orbiter	Centrifuge
TBD*	**1E**	U.S. Orbiter	Columbus Orbital Facility

* Launch dates after Flight UF-5 are under evaluation while launch options for the Columbus Orbital Facility are analyzed. These dates are expected to be set at the Space

Station Control Board meeting in Fall 1997. U.S. Habitation Module outfitting will be completed by December 2002.

Web Resources

The International Space Station Website

NASA's homepage

NASA's Office of Human Space Flight

The European Space Agency

The National Space Development Agency (NASDA-Japan)

The Space Studies Board of the National Research Council

Sources:

- *Testimony of Dr. Lawrence J. DeLucas, Center for Macromolecular Crystallography, presented to the House Committee on Science Subcommittee on Space and Aeronautics*
- *Testimony of Robert L. Park, University of Maryland Physics Department, presented to the House Committee on Science Subcommittee on Space and Aeronautics (April 9, 1997)*
- *Eugene Bierly, AGU*
- *Testimony of Thomas F. Rogers, Advisor to the Space Frontier Foundation, presented to the House Committee on Science (November 8, 1995)*
- *Testimony of Dr. John H. Gibbons, Director of the Office of Science and Technology Policy, presented to the House Committee on Science (February 12, 1997)*
- *Statement of F. James Sensenbrenner, House Committee on Science Chairman (April 9, 1997)*
- *Press Releases from the office of Rep. Tim Roemer (May 23, 1995; June 28, 1995; May 30, 1996; December 4, 1996; February 12, 1997; April 21, 1997; April 23, 1997)*
- *The American Institute of Physics Bulletin of Science Policy News (July 1997)*
- *The American Institute of Physics*
- *NASA's Office of Legislative Affairs*
- *Science magazine*
- *The Washington Post*
- *Committee Adopts Space Station Amendment, Press Release of the House Committee on Science (April 17, 1997)*
- *House Committee on Science Hearing on the FY 1998 NASA Authorization (April 9, 1997)*

Please send any comments or requests for information to the **AGI Government Affairs Program** at govt@agiweb.org.

Contributed by Jenna Minicucci, AGI Government Affairs Intern

Last updated August 13, 1997

http://www.agiweb.org/

American Geological Institute Home Page

http://www.agiweb.org/agi/gaphome.html

Government Affairs Program Home Page